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ABSTRACT

This instructional guide, one of a series developed by the Technical Education Advancement Modules (TEAM) project, is a 16-hour introduction to plant floor operations. The guide is designed to develop the following competencies: (1) understanding the characteristics and components of personal computer (PC) networks; (2) computer networking operations; (3) workstation interconnection (PC network topologies); and (4) transmission media. The module is intended to upgrade basic technical competencies of unemployed, underemployed, and existing industrial employees. The materials in this module serve as a student outline and an instructor guide. The manual includes four units, each focussed on one of the four competencies. Textbooks needed to accompany the manual are listed. Statements of objectives for all four units are grouped together at the beginning of the manual and are followed by handouts relevant to each unit and explaning the specific content to be learned. (NLA)

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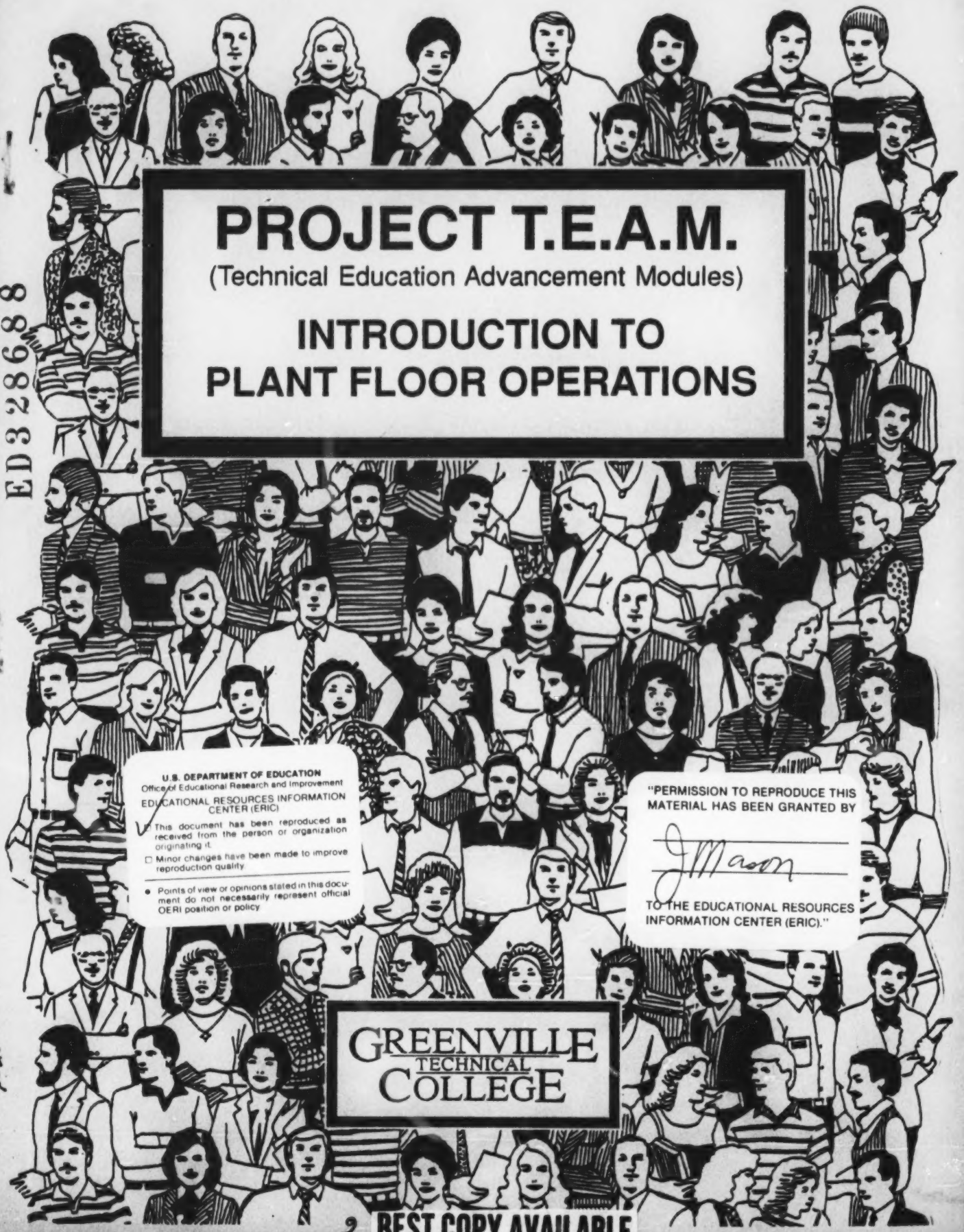
PROJECT T.E.A.M.

(Technical Education Advancement Modules)

INTRODUCTION TO PLANT FLOOR OPERATIONS



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PROJECT TEAM
TECHNICAL EDUCATION ADVANCEMENT MODULES

INSTRUCTIONAL MODULE:

INTRODUCTION TO PLANT FLOOR OPERATIONS

Developed by:

Leii Mao

Funded by:

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Introduction:

The purpose of this manual is to serve as an instructional guide for the TEAM Grant module Introduction to Plant Floor Operations.

Introduction to Plant Floor Operations is a sixteen hour overview course intended to develop competencies in the following skill areas:

Understanding the Characteristics and Components of PC Networks
Computer Networking Operations
Workstation Interconnection
Transmission Media

Overview of Project TEAM:

Project TEAM (Technical Education Advancement Modules) is a program targeted toward the unemployed, underemployed, and existing industrial employees who are in need of upgrading basic technical competencies. The program seeks to give adequate preparatory educational opportunities in generic technical skill areas and to create a public awareness of the need for these basic skills. Curriculum content was determined by an assessment team of local industrial employers. Their evaluation resulted in the development of 15 instructional modules; some of which may be industry specific, but most of which are applicable in and necessary to a majority of industrial settings. The modules may be used collectively or as a separate curriculum for a specific course or courses. The material contained in each manual will serve as a student outline and as an instructor guide which may be used selectively or in its entirety.

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CIM Certificate Program
PC NETWORKS

UNIT 1

INTRODUCTION TO PC NETWORKS

TIME REQUIRED: 2 Lecture Hours

REFERENCE: Local Networks, 3rd ed., Stallings, MacMillan

OBJECTIVES: With effort on your part, on completing Unit 1 you will be able to:

1. Describe what is PC Network?

2. Explain why we need PC Network?

3. Identify and describe typical characteristics of PC Networks

4. Identify and describe components of pc network.

CIM Certificate Program
PC NETWORKS

UNIT 2

COMPUTER NETWORKING

TIME REQUIRED: 8 Lecture Hours

REFERENCE:
1. Local Networks, 3rd ed., Stallings, MacMillan
2. Black Box Corporation, The LAN Catalog

OBJECTIVES: On completing Unit 3, you will be able to accomplish the following:

1. Describe the concept of Open Systems
2. Draw OSI Architecture
3. Discuss Protocols
   a. physical layer
   b. data link layer
   c. network layer
   d. transport layer
   e. session layer
   f. presentation layer
   g. application layer

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UNIT 3

PC NETWORK TOPOLOGIES

TIME REQUIRED: 3 Lecture Hours

REFERENCE:
1. Local Networks, 3rd ed., Stallings, MacMillan
2. Local Area Networking with Microcomputers

OBJECTIVES: On completing of this unit of study, you will be able to:

1. Determine why a network topology is needed
2. Discuss the sturcture and operation of
   a. the Star Topology
   b. the Ring Topology
   c. the Bus and Tree Topologies
3. Discuss choice of topology

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UNIT 4

TRANSMISSION MEDIA

TIME REQUIRED: 4 Lecture Periods

REFERENCE: HANDOUTS

OBJECTIVES: On completion of this unit of study, you will be able to:

1. Describe the characteristics of transmission media
   a. physical description
   b. transmission characteristics
   c. connectivity
   d. geographic scope
   e. noise immunity
   f. relative cost
2. Discuss three different types of transmission media
   a. Twisted Pair
   b. Coaxial Cable
   c. Optical Fiber Cable
3. Discuss choice of transmission media

UNIT 1

INTRODUCTION TO PC NETWORK

A. A DEFINITION OF PC NETWORKS

I. WHAT IS PC NETWORK?

A PC network is a communications network that provides interconnection of a variety of data communicating devices within a small area. It also called Local Area Network (LAN).

II. WHY WE NEED PC NETWORK?

* To share and exchange data between systems.
* To share expensive resoures.

III. TYPICAL CHARACTERISTICS OF PC NETWORK

* High data rates - 1 to 100 Mbps (Mega bits per second)
* Short distance - 0.1 to 25 Km (Kilo meter)
* Low error rate - 10^-8 to 10^-11

B. COMPONENTS OF PC NETWORK

I. WORKSTATIONS:

These including all 8086, 286, 386 base personal computers (PCs) and Apple Mac Warkstations.

II. NETWORK INTERFACE CARD (NIC):

The Network Interface Card will plug into one of the available slots on mother board of PC for sending and receiving messages.

III. T CONNECTOR:

Attached to Network Interface Card for cable connection.

IV. TRANSMISSION CABLE:

To network Workstations together so that message can be sent from one workstation to another. The cable varys from low cost twisted pair telophone wires to single or multichannel coaxial cable, to expensive, high performance fiber optics.

V. FILE SERVER:

The File Serve is the Workstation which manages the shared hard disk. In the Local Area Networks, File Server does not run application programs.

VI. APPLICATION SOFTWARES

To accomplish all the routine procedures like the sorting files and troubleshooting that make a system easier to use.

Application softwares such as databases, word processing, and communication software can be easily distributed to each workstation in the Network. LANs also allow important information to be easily distributed to the proper people through network utilities such as email, diagnostics software, and file transfer utilities.

VII. NETWORK OPERATING SYSTEMS (NOS)

The network operating system is usually implemented as a shell around the disk operating system; it redirects network calls.

VIII. TOPOLOGY

LAN cabling is arranged in a predetermined configuragion. If can be described as the physical pattern of interconnection between nodes. The most common topologies are bus, ring, and star.

IX. PROTOCOLS

Formal rules and conventions governing the exchange of messages between LAN devices.

UNIT 2

COMPUTER NETWORKING

I. THE CONCEPT OF OPEN SYSTEMS

In 1979, the International Standards Organization (ISO) began to develop a computer network reference model called the Open Systems Interconnection (OSI) model. It describes the general pieces that a network should contain. In the OSI model, a "system" consists of a computer, all of its software, and any peripheral devices attched to it.

An open system consists of a number of application, an operating system, and system software such as data base management system and a termainal handling package. It also includes the communications software that turns a closed system into an open system. Different manufacturers will implement open systems in differnet ways, in order to achieve a product identity, which will increase their market share or create a new market. However, virtually all manufacutrers are now committed to providing communications software that behaves in conformance with OSI in order to provide their customers with the ability to communicate with other open systems.

II. THE OSI MODEL

The OSI model uses a modular approach. Each module in the model represents a layer. Each layer performs a related subset of the functions required to communicate with another. It relies on the next lower layer to perform more primitive functions and to conceal the details of those functions. It provides services the next higher layer. Networking services are in the form of software functions provided by computer programs in each layer.

Figure X illustriates the OSI model in a system for it to communicate. Of course, it takes two to communicate, so the same set of layered functions must exist in two systems. Communication is achieved by having the corresponding ("peer") layers in two wystems communicate. The peer layers communicate by means of a set of rules, or conventions, known as protocol.

III. THE KEY ELEMENTS OF A PROTOCOL

The key elements of a protocol are:

* Syntax: the form in which information is exchanged (format, coding).
* Semanitcs: the interpretation of control information for coordination and error handing.
* Timing: The sequence in which control events occur.

IV. PROTOCOLS

(1) Physical Layer

The physical layer provides for transmission and reception of bit streams across transmission medium. The most common standard in use today is RS-232-C.

The physical layer has four major characteristics

* Mechanical

  The mechanical characteristics pertain to the point of demarcation. Typically, this is a pluggable connector. RS-232-C specifies a 25-pin connector, so that up to 25 separate wires are used to connect the two device.

* Electrical

  The electrical characteristic have to do with the voltage levels and timing of voltage changes, These characteristics determine the data rates and distances that can be achieved.

* Functional

  The functional characteristics specify the functions that are performed by assigning meaning to various signals. For RS-232-C, and for most other physical layer standards, this is done by specifying the function of each the pins in the connector.

* Procedural

  The procedural characteristics specify the sequence of events for transmitting data, based on the functional characteristics. For RS-232-C, the use of the various pins is defined.

(2) Data Link Layer

Data link layer provides for the reliable transfer of data across the physical link (link establishment), error detection, simple correction flow control, handling of multiple links.

(3) Network Layer

Network link provides for message blocking, higher forms of error recovery, association of network and physical address, internetwork routing, and also responsible for establishing, maintaining, and terminating connections.

Layers 4 and above of the OSI model are generally referred to as the higher layers. Protocols at these levels are end-to-end and not concerned with the details of the underlying communications facilities.

(4) Transport Layer

Provides reliable, transparent transfer of data between end points; network management; and provides end-to-end high level error recovery and flow control at network level.

(5) Session Level

Provides the control structure for communication between applications; establishes, manages, and terminates connections (sesions) between cooperating applications; queuing or buffering of received data; and recovery of terminated seeions.

(6) Presentation Level

Performs generally useful conversions on data or code to provide a standardized application interface and to provide common communications services; example: encryption, text compression, reformatting.

(7) Application Level

Provides services to the users of OSI environment; examples: transaction server, file transfer protocol, management of relationship between communications process and application program being served.

V. SUMMARY

Table 3-1 is organized in the OSI hierarchical stack to help you visualize the software and hardware components of various Local Area Networks. At the top of the stack you find application software (such as databases, word processing, and communications software). You will also find network utilites such as email, diagnostics software and file-transfer utilities. The network operating system (NOS) is usually implemented as a shell around the disk operating system; it redirects network calls. The NOS shell specifies the way the application program talks to the lower level networking protocols. This may be done with a standard interface such as NetBIOS or a proprietary interface wuch as NOVELL SPX.

Most network operating systems implement transport and network protocols in main memory. These protocols may also be implemented on the network interface card for expecially fast performance.

Most network interface cards implement the two bottom layers of the protocol stack - the datalink and the physical.

UNIT 3

PC NETWORK TOPOLOGIES

I. WHY A NETWORK TOPOLOGY IS NEEDED

The term "topology" refer to the way in which workstation of the network are interconnected. The goal of network topology is to find the most economical and efficient way to connect workstation togethewr. Network topology not only provide adequate capacity to handle user demands also maintain system reliability and keep delay low.

II. PC NETWORK TOPOLOGIES

(a) The Star Topology

In the star topology, each workstation is connected by a point-to point link to a common central device (Figure 4-1). Communication between any two workstations is via circuit switching. For a workstation to transmit data, it must first sent a request to the central switch, asking for connection to some destination station. Once the circuit is set up, data may be exchanged between the worktwo stations as is they were connected by a dedicated point-to-point link.

(b) The Ring Topology

In the ring topology, the pc network consists of a set of repeaters joined by point-to-point links in a closed loop. Hence each repeater participates in two links (Figure 4-2). The repeater is a comparatively simple device, capable of receiving data on one link and transmitting it, bit by bit, on the other link as fast as it is received, with no buffering at the repeater. The links are unidirectional; that is, data are transmitted in one direction only, and all oriented in the same way. Thus data circulate around the ring in one direction.

(c) The Bus Topology

With the bus topology, the communications network is simply the transmission medium - no switches and no repeaters. All workstations attach, through appropriate hardware interfacing, directly to a linear transmission medium, or bus. A transmlission from any workstation propagates the length of the medium and can be received by all other workstations.

Because all nodes on a bus share a common transmission link, only one workstation can transmit at a time. Some form of access control is required to determine which workstation may transmit next.

III. CHOICE OF TOPOLOGY

The choice of topology depends on a variety of factors, including reliability, expandability, and performance.

(a) Bus Topology

The bus topology appears to be the most flexiable one. It is able to handle a wide range of workstation, in terms of number of workstation, data rates, and data types. Expansion and reconfiguration of a bus network are easy. A new or relocated device may be connected to the nearest convenient network access point with little disruption of the network. Connecting microcomputers and devices from different manufacturers is difficult because all devices must accept the same forms of address and date. Performance of bus topology is excellent under ligh load but it may degrade rapidly as load increase. Over all speaking, bus topology is a good choice for small network with low traffic.

(b) Ring Topology

Very high speed links can be used between the repeaters of a ring. Hence, the ring has the potential of providing the best throughout of any topology. There are practical limitations, in terms of numbers of devices and variety of data types. Add or delete workstations from a ring is moderately easy. System modification costs are relatively low. Expansion disrupts the sylkstem. Performance under heavy traffic remains stable with less increase in delay and degradation of service than other networks. Transmission delays are long, however, even under light traffic. Failure in a workstation or in the channel causes the system failure because of the interdependence of workstations. Locating a failed repeater is difficult.

(c) Star Topology

The star topology, using circuit switching, is the best way to integrates voice with data services. It lends itself well to low-data-rate (<64 kbs) devices. The star topology is good for terminal-intensive requirements because of the minimal processing burden that it imposes on the attached devices.

UNIT 4

TRANSMISSION MEDIA

I. CHARACTERISTICS OF TRANSMISSION MEDIA

The transmission media is the physical path between a point-to-point link between two devices in a network. Point-to-point link are used in the ring topology to connect adjacent repeaters, and in the star topology to connect deveices to the center switch. The three basic types of transmissin media are:

* Twisted Pair

* Coaxial Cable

* Optical Fiber Cable

Each medium will be described by a set of characteristics. The characteristics are:

* Physical description: the nature of the transmission medium.

* Transmission characteristics:

  include whether analog or digital signaling is used, modulation technique, capacity, and the frequency range over which transmission occurs.

* Application:

  include point-to-point or multipoint and the maximum distance between points on the network.

* Noise immunity:

  resistance of medium to contamination of the transmitted data.

* Relative cost:

  based on cost of components, installation, and maintenance.

II. TWISTED PAIR - The most common transmission medium

Physical Description

A twisted pair consists of two insulated copper wires usually 22 to 24 gauge. The twisting of the individual pairs minimizes electromagnetic interference between the pairs.

Transmission Characteristics

Twisted pairs may be used to transmit both analog and digital signals. For analog signals, amplifiers are required about every 3 to 4 miles. for digital signals, repeaters are used every 1 to 2 miles.

The most common use of twisted pair is for analog transmission of voice at 4000 Hz. Digital data may be transmitted over an analog voice channel using a modem. It is also possible to use digital or baseband signaling on a wire pair. Bell offers a T1 circuit using twisted pair which handles 24 voice channels for an aggregate data rate of 1.544 Mbps. Higher data rates, depending on distance, are possible.

Application

Twisted pair can be used for point-topoint and multipoint applications where low speed, low demand devices are interconnected. Twisted pair is typically used in star, bus, and ring topologies within a single building or just a few buildings.

Noise Immunity

Compared to other guided media, twisted pair is limited in distance, bandwidth, and data rate. The medium is quite susceptible to interference and noise because of its easy compling with electromagnetic fields. Noise Immuinity can be as high or higher than for coaxial cable for low frequency trnasmission. However, above 10 to 100 KHz, coaxial cable is typically superior.

Cost

Twisted pair is less expensive than either coaxial cable or fiber in terms of cost per foot. However, because of its connectivity limitations, installation costs may approach that of other media.

III. COAXIAL CABLE - The most versatile transmission medium.

Physical Description

There are two types of coaxial cable curretly in use for local network applications: 75-ohm cable, which is the standard used in cable TV (CATV) systems, and 50-ohm cable, which is used exclusively for digital trnasmission.

Transmission Characteristics

Coaxial cable provides a high bandwidth for high data rate communication networks. The relationship bandwidth and data transmission rate can bc assumed by 1 Hz per bps for rates of 5-Mbps and above and 2 Hz per bps for lower rates. For example, a 5-Mbps data rate can be achieved in 6-MHz TV channel, whereas a 4.8-Kbps modem might use about 10-Khz.

Application

In most respects, coaxial cable is similar to twisted pairs. Coaxial cable are frequently used for bus networks. In high speed transmission (50-Mbps), digital or analog, the maximum distance for coaxial cable is limited to about 1 mile. Because of the high data rate, the physical distance between signals on the bus is very small. Hence very little attenuation or noise can be tolerated before the data are lost.

Cost

The cost of installed coaxial cable falls between that of twisted pair and optical fiber.

IV. OPTICAL FIBER

Physical Description

An optical fiber is a thin, flexible medium capable of conducting an optical ray. Various glasses and plastics can be used to make optical fibers.

An optical fiber cable has a cylindrical shape and consists of three concentric sections: the core, the cladding, and the jacket. The core is the innermost section, and consists of one or maore very thin fibers made of glass or plastic. Each fiber is surrounded by its own cladding, a glass or plastic coating that has optical properties different from those of the core. The outermost layer, surrounding one or a bundle of cladded fibers, is the jacket. The jacket is composed of plastic and other materials layered to protect against moisture, abrasion, crushing, and other environmental dangers.

Transmission Characteristics

Optical fiber can perform a data transmission rate in giga (10 to the 9th power) bits per second with very low error rates. The electrical signals are translated into light pulses by a modulator, transmitted over the fiber by a ligh source, and detected and converted back to electrical signals by photoelectric diodes.

Two different types of light source are used in fiber optic systems: the light-emitting diode (LED) and the injection laser diode (ILD). The LED is less costly, operates over a great temperature range, and has a longer operational life. The ILD is more efficient and can sustain greater data rates.

Application

The most common use of optical fiber is for point-to-point links such as star or ring topologies. Experimental multipoint systems using a bus topology have been built, but are too expensive to be praticle today. Present technology supports transmission over distance of 4 to 5 mile without repeaters. Hence optical fiber is suitable for linking local networks in sereral buildings via point-to-point links.

Noice Immunity

Optical fiber is not affected by electromagnetic interference or noise. This characteristic permits high data rate over long distance and provides. excellent security.